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Enhancing Students' Online Learning Experiences with Artificial Intelligence (AI): The MERLIN Project

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Abstract. The COVID-19 pandemic led to all institutions of education having to transition to fully online learning almost immediately. However, research showed that online learning still lacked adequate interactions with students. This is even more problematic when students are online learning on their own, when adequate online scaffolding activities are absent. This study investigated the impact of chatbots as a scaffolding agent to assist student learning during their independent online learning times. A total of 62 Diploma level students participated in this mixed method research study and presented with a multimedia-based AI chatbot named MERLIN. Data was collected on their attitudes towards using it. Results showed that students were motivated to learn more using MERLIN, improved their learning, and wanted more chatbots in their other courses. These findings have important implications for using AI chatbots as a scaffolding and instructional tool in 21st-century learning environments.

Keywords: Artificial intelligence; Chatbot; Learner experience; Multimedia learning; Scaffold

1. Introduction

The move towards online learning has been accelerated in many institutions of higher education, which were previously predominantly face-to-face. The use of technology in the classroom is growing as educators seek to innovate the teaching and learning process with emerging technologies and ICT (Berawi, 2020a; Godin & Terekhova, 2021). These technologies include blended learning web tools such as Kahoots, Padlet, blogs, simulations, and social media. For many universities, integrating technology into the classrooms and harnessing the potential of blended learning tools resulted in a smoother transition to online learning environments when the COVID-19 pandemic hit. In Malaysia, the COVID 19 global health crisis led to a total lockdown in the country, resulting in schools and universities making emergency transitions to fully online classes. While some institutions could make the shift with little to no effort, for many, the transition to online learning was a drastic change that left them unprepared and challenged (Azlan et al., 2020). While many universities could rely on the support of their Learning Management Systems (LMS) and blended learning tools, the online learning environment still lacked adequate

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interaction with students. Much of this was because these online learning environments were deficient in their instructional design and as such, need to be redesigned with appropriate support and activities that allow students to better interact with their learning materials (Liguori & Winkler, 2020). This is even more problematic when students are learning independently online, without the presence and support of their lecturer (Keshavarz, 2020). During these times, the need for interaction and a proper support system is higher than when they are in their online classes. Doyumgaç et al. (2021) state that it is unrealistic to depend on students to regulate their learning and engagement processes when studying independently online and call for appropriate methodologies and measures to support them when they are learning asynchronously online. In addition, in the absence of the instructor, learning activities that encourage active participation and allow students to engage in the learning content before and after their online classes need to be designed and implemented (Allo, 2020). In other words, students need to have some form of scaffolding activities to enable them to better engage with their learning content.

According to Zaretsky (2021), scaffolding is an important instructional strategy as it assists students in building upon their current level of knowledge. Proper scaffolding enables students to better understand new concepts, develop new skills and move from what they know now to what they need to know. Scaffolding is underpinned by socio-constructivism which suggests that the learning process is enhanced when more experienced peers or tutors assist students. Research studies have shown that scaffolding has been an effective instructional strategy to engage learners and improve learning outcomes (Belland, 2017; Doo et al., 2020). Martha et al. (2019) suggests that motivation must be included in its design when providing scaffolding support through pedagogical agents. Scaffolding can include fishbowl and think-aloud activities, chunking of information into digestible micro modules and delivered incrementally, visual aids, providing examples, and modeling the process for the learners. When applied to the current educational landscape, these scaffolds can be further developed by utilizing the potential of technology, making them available to students anytime and anywhere. The 2020 Horizon Report (Brown et al., 2020) posits that learning environments can benefit greatly through the incorporation of mixed reality technologies such as Augmented Reality, Artificial Intelligence, Virtual Reality, and adaptive learning tools. Research has shown that the use of these emerging technologies has had positive effects on the learning process, and has the potential to innovate online learning environments in an impactful manner. Using AI is beneficial in decision-making and can simplifying complex processes (Berawi, 2020b; Siswanto et al., 2022). Research by Gaglo et al. (2021) showed that Artificial Intelligence (AI) can contribute significantly to the educational field, and suggests using chatbots as instructional tools to assist students when they are learning independently online.

A chatbot was presented by Clarizia et al. (2018) that served as an e-Tutor to support the e-learning system. The framework mapped the learning object metadata instances into the ontology. Subsequently, the learners' intention was associated with the ontology by adopting Latent Dirichlet Allocation. Neto and Fernandes (2019) proposed a chatbot for online collaborative learning with an Academically Productive Talk (APT) structure. The APT proposed the movements to encourage discussions and social interactions among the learners. Apart from that, the Conversational Analysis was incorporated into the chatbot to support the teachers in monitoring online collaborative activities. A Bengali chatbot called "Doly" was put forth in Kowsher et al. (2019). The Bengali chatbot enabled the learners to type their questions in the Bengali language. To answer the learner's question, the chatbot leveraged a search algorithm to obtain the matching results from the corpus. Subsequently, the final answer to the question was selected by the Naïve Bayesian algorithm. Winkler et

al. (2020) devised a web-based chatbot, known as "Sara", that was integrated into the online video lectures. Sara intervened in the learning process when the learners were watching the videos by asking relevant questions and providing detailed explanations. The voice-based and text-based scaffolds in Sara helped learners to retain the information better and transfer knowledge. A chatbot to teach programming in primary education, referred to as the "Prof. Watson" was presented by Yeves-Martínez and Pérez-Marín (2019). The IBM Watson Assistant service empowered Prof. Watson. The dialog flow in the chatbot was designed based on the methodology of teaching programming in primary education with the use of metaphors.

While there is some evidence that AI chatbots are being used in institutions of higher education (Gaglo et al., 2021), they are still very much in the corporate and medical sectors in Malaysia (Lee et al., 2020), providing customer care services. To date, there is very little evidence in research of chatbots being used in Malaysia for educational purposes, as this technology is still in its infancy in the country. As such, the role and impact of AI chatbots as learning scaffolds for Malaysian educational institutions need to be further investigated. Therefore, this research study investigates the role and impact of using an AI chatbot as an instructional tool and scaffold for students in an online learning environment, specifically when they are learning independently and without the lecturer's presence. This research was conducted to answer the research question, ***"What is the impact of using an AI chatbot as a scaffolding agent on the students' online learning experiences****?"*, and to present a learning framework for the effective use of AI chatbots as scaffolding agents in the virtual learning environments. This research was guided by the current issue prevalent in the Faculty of Creative Multimedia that design students, who do a lot of their learning online and outside of their classes, lack lecturer support and interactions during these times. Learning is thus truncated until they meet their lecturer again during class time. During this time, retention of the information is lowered, and knowledge is unsustained. The development of the MERLIN chatbot would bridge that gap by providing assistance and support during independent online learning times. However, since this would be a new technology for students to use, their readiness and acceptance of the chatbot for these scaffolding purposes would need to be assessed, in addition to their learning experiences in using a chatbot during their independent online learning times (Salloum et al., 2019).

2. Method

2.1. Learning with AI – The MERLIN Project

The AI chatbot, MERLIN, was developed as part of a program to use mixed reality technologies in classrooms called MERLIN's Playground conducted in Multimedia University, Malaysia. The MERLIN Project focused on designing and developing a chatbot as a virtual scaffold and learning assistant for students learning independently online.

In MERLIN chatbot, natural language processing (NLP) is used to understand the meaning of the student input in text description form. When students interact with the chatbot, the chatbot will process their input sentences through different NLP models before responding to students. There are two main things that the chatbot needs to extract from the sentences which are entity and intent. The entity represents the object in the sentences, while the intent represents the purpose of the sentences. It is more challenging to capture the sentence's intent since it might not have a clear purpose. The entities to be identified include human names, positive words, dates, and more. Since not all entity types can be detected by the pre-trained models in MERLIN chatbot, training a customized model is required to capture specific types of entities. For instance, when the student enters his/her name, the pre-trained human name detector model will capture the human name in the

sentence. Another example is when the student enters *"I want to do a quiz"*, the customized entity model will detect the word "*quiz*" and trigger the quiz module. Besides the pre-trained entity model, the MERLIN chatbot allows the developers to train their customized entity models. Specifically, the customizable entity model is a Conditional Random Field (CRF) model that is trained to detect the entity in different sentence variations. Training a customizable entity model requires a set of training samples. For instance, to detect the entity "*3-point lighting example*", the model needs to collect different sentences related to "*3-point lighting example*" as the training samples, such as "*Show me some three-point lighting examples*" and "*what is 3-point lighting example*". Since entity model training does not require labeled samples, all sentences do not map to a label.

As for the intent models, several customized intent models were created to capture the desired intent from the input sentences. For example, when the student key in "*I want to know about 3-point lighting example*", a customized intent model needs to understand the purpose of this sentence where it requests the examples of 3-point lighting and returns the correct contents to the student. For intent models, a Bernoulli Naive Bayes (BNB) model (Metsis et al., 2006; Manning et al., 2008) was trained to recognize the purpose of the sentences related to "*Faraday's law application*". In intent models, many labelled training samples are required, which can be grouped as positive and negative samples. For example, "*I want to know about the application of Faraday's Law*" and "*Get application of Faraday's Law*" belong to positive samples. In contrast, "*The importance of Faraday's Law*" and "*The Faraday's Law explanation*" belong to negative samples. The model needs to learn and capture the purpose of the training sentences that are truly related to the "*Application of Faraday's Law*" although the negative samples also contain the phrase "*Faraday's Law*" With this model, the MERLIN chatbot will return the relevant information to the students based on their queries. Figure 1 shows some examples of the content returned to the students.

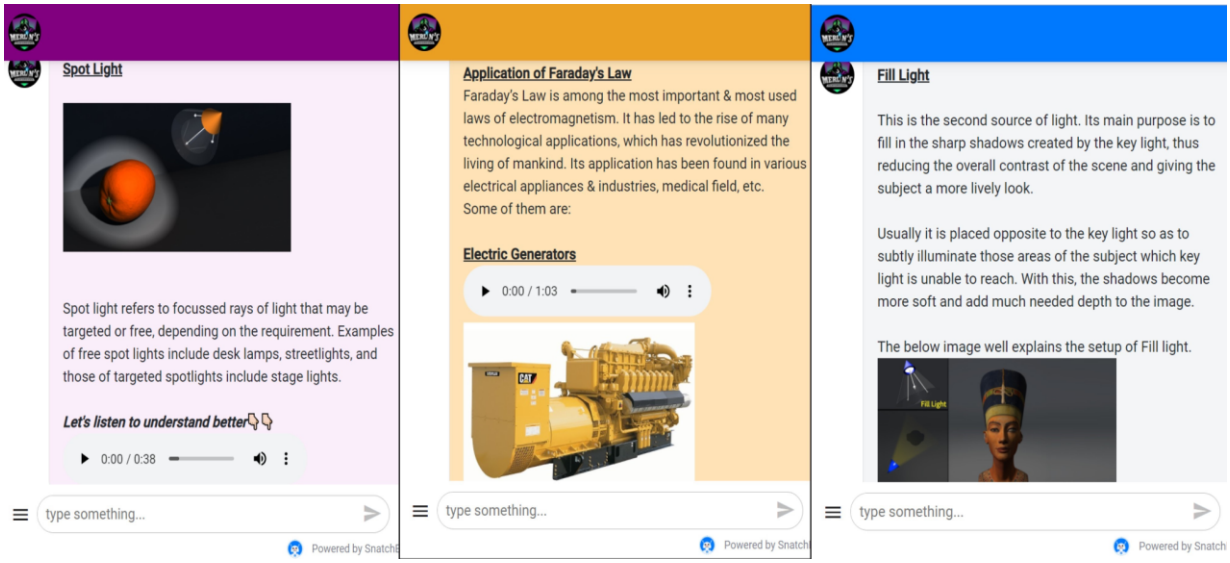

Figure 1 MERLIN returning the relevant information to students' queries

The learning content in the chatbot was customized to the syllabus from a design course taught in the Faculty of Creative Multimedia, Multimedia University, called *"Lighting in 3D modeling"*. The aim was to create a conversational AI chatbot that could scaffold students when they were learning online without the presence of their lecturer. The interaction between the chatbot and the learner was underpinned by Natural Language Processing (NLP) features, using the Conditional Random Field (CRF) entity model and the Bernoulli Naive Bayes (BNB) intent model, where conversations simulated intelligent

human language interactions. In addition, the content in the chatbot was redesigned using multimedia elements such as videos, narrations, and animations. The final learning content that the chatbot would return, would be media-rich, comprehensive and visually appealing. This would provide students a multi-sensory learning experience with a chatbot within a human-like interactive learning environment. In particular, the chatbot was designed to provide content that was multimedia-based learning materials to differentiate it from the conventional chatbots used in non-educational environments. A self-efficacy quiz was also provided to the learner to assess themselves and to reflect on their scores, as learners' self-efficacy has been shown to impact their attitudes towards using the technology (Abdullah & Ward, 2016). Based on their scores, they would then have the opportunity to go back to MERLIN to further study the areas they were weaker in or to feel more confident in their newly acquired knowledge of the topic.

2.2. Methodology

This study employed a convergent mixed method research design to collect and analyze both qualitative and quantitative data solicited from the students in one phase. A 22-item survey questionnaire was administered to students in the Faculty of Creative Multimedia to gauge their attitudes towards using this AI chatbot. These students were taking their Diploma in Creative Multimedia, enrolled in a design course, and learning about *"Lighting in 3D modeling"*. Research has shown that many e-learning applications have been developed to create more technologically-supported learning environments (Asvial et al., 2021). However, there is still a lack of confidence and sound pedagogical support for these environments, and therefore, still a need to assess their effectiveness and the readiness of the learners to use them (Salloum et al., 2019). The Technology Acceptance Model (TAM) by Davis (1989) has been widely used to gauge user preparedness over a wide range of technology (Tao et al., 2022; Yeo et al., 2022). In it, the model suggests that users' intention to use a particular technology is predicated upon their perception of its usefulness (PU) and its ease of use (PEOU), which then results in their evaluated attitudes (ATU). The model also suggests that PU and PEOU are the student learning experiences that are cognitive while ATU is their positive or negative emotional assessment of the technology, which will impact their decision to use that technology in the future. Content, navigation, self-efficacy, enjoyment, media features, and instructional quality can also have an impact on the students' Intention to Use (IU) the technology (Abdullah & Ward, 2016; Tao et al., 2022).

In this study, since using an AI chatbot would be new for them, their acceptance and perceptions of using it was investigated. Therefore, Davis (1989) Technology Acceptance Model (TAM) model was chosen. The study's survey adapted the model to investigate students' Intention to Use (IU) chatbots in their learning process. Data was collected from students to gauge their perceptions of the MERLIN chatbot's Perceived Usefulness (PU) and Perceived Ease of Use (PEOU), which consequently would affect their Attitudes Towards Usage (ATU) of the chatbot, and, ultimately, their preparedness to use chatbots in the future. In particular, the survey sought to investigate these key determinants through these 4 constructs:

1) Level of understanding (6 survey items mapped to Perceived Usefulness (PU))
2) Chatbot content and ease of navigation (6 survey items mapped to Perceived Ease of Use (PEOU))
3) Motivation (6 survey items mapped to Attitudes Towards Usage (ATU))
4) Use of Virtual Assistants in Learning (4 survey items mapped to Intention To Use (IU))

The survey was a 5-point Likert scale questionnaire, ranging from 5 (Strongly Agree), 4 (Agree), 3 (Undecided), 2 (Disagree), and 1 (Strongly Disagree), and was conducted

voluntarily. Students were given a short briefing on the study and were informed that the survey would not affect their course grades. They were then given a consent form to fill up and the option to not participate. A total of 62 students agreed to be part of the study, with 18 students opting not to participate. Students who agreed to participate were directed to the chatbot's link and given 30 minutes to explore MERLIN before completing the questionnaire. In addition, and as part of the convergent mixed method research design, qualitative data was collected from open-ended questions soliciting student comments. These comments were integral to gauge students' perceptions towards using MERLIN as a scaffolding tool in their independent online learning process. They were also analyzed and compared with the survey's results to support this study's findings.

3. Results and Discussion

The study's findings were analyzed with SPSS v27 to answer for research question, ***"What is the impact of using an AI chatbot as a scaffolding agent on the students' online learning experiences?".*** Findings of the entire survey are presented in Table 2, where survey item means (M) are shown, as well as the percentage of positive responses, p, (i.e., students who scored 4 (Agree) and 5 (Strongly Agree) on the survey). Reliability analysis was performed on the survey and yielded a Cronbach Alpha of 0.93, confirming that the survey results were reliable. To better understand the findings on each of the constructs, the survey is further categorized into 1) Level of Understanding, 2) Chatbot Content and Ease of Navigation, 3) Motivation, and 4) Use of Virtual Learning Assistants in Learning. Tables 1-4 present the items for each of the constructs items from the questionnaire, and their supporting student comments.

Table 1 Survey findings for Level of Understanding

	Item Name	Mean (M)	% responses
1.	The Merlin Assistant cleared doubts	3.98	69.4
2.	The additional info was quite helpful.	4.18	79.03
3.	The inclusion of a quiz in the MERLIN Virtual Assistant further helped in assessing the authenticity of my understanding of the topic.	3.89	72.10
4.	The MERLIN virtual assistant tool enhanced my understanding of this topic in an interesting & engaging manner.	3.84	69.36
5.	The MERLIN Virtual Assistant helped me strengthen my retention of the topic.	3.97	70.3
6,	I found Merlin Virtual Learning Assistant informative and engaging.	3.97	77.05

As shown in Table 3, 69.4% of students also reported that MERLIN was able to clarify and clear any doubts that they had for certain questions they had in mind (Item 1, M = 3.98), and in doing so, strengthened their retention in the topic (Item 5, M = 3.97, p = 70.3%). 72.1% of the students found that taking the quiz allowed them to assess better their level of understanding of the topic (Item 3, M = 3.89), and 79% of them reported that the additional information given was very helpful (Item 2, M = 4.18). 69% of students reported that Merlin enhanced their understanding of the topics (Item 4, M = 3.84) and 77% of them found Merlin to be informative and engaging (Item 6, M = 3.97). The data were also supported by student comments that MERLIN was able to enhance their understanding of the topic, as students commented that, *"[MERLIN] Makes revising more accessible and easy", "I can simply test my understanding … after I learn something new", "[MERLIN] Clear up any confusion I have regarding certain topics",* and, *"Merlin doesn't confuse me when it shows the*

explanation of the topic, it keeps it simple and easy to understand making it easier and faster to digest what the topic is about". They also pointed out that using MERLIN helped them to save time and effort of searching for the information themselves on Youtube and trying to understand them on their own, and having the quiz features enabled them to self-evaluate their level of knowledge.

Table 2 Survey findings Chatbot Content and Ease of Navigation

	Item Name	Mean (M)	% responses
1.	I was able to navigate through MERLIN easily from start to finish.	3.90	66
2.	The content in the MERLIN Virtual Assistant was well-organized and followed a suitable sequence for understanding a topic.	4.03	83.34
3.	The language and the content of the MERLIN Virtual Assistant was easily understandable.	4.31	79
4.	The inclusion of web links and visual aids, such as videos & images, in the MERLIN Virtual Assistant further helped in clarity of the topic.	4.24	76
5.	I had no problem going through MERLIN on my own.	4.02	70.49
6.	It was easy for me to become skillful at using the Merlin Virtual Assistant.	3.90	66.13

Table 2 shows the majority of students reported that navigating through MERLIN was not difficult, with 66% of students stating that they were able to navigate easily within the chatbot (Item 1, M = 3.90), and 70% of them being able to navigate MERLIN easily on their own (Item 5, M = 4.02). In addition, 79% of students found the language and content in MERLIN easily understood (Item 3, M= 4.31). 76% of students reported that the inclusion of media-rich elements such as videos and images better-explained concepts (Item 4, M = 4.24), and 66% of them reported that they could easily become skilful at using MERLIN (Item 6, M = 3.90).

Student comments also showed positive support for content and navigation in MERLIN, as many stated that they found the content easy to understand and to navigate in MERLIN, commenting that, *"Merlin provided videos, images and even audio explanations which is easy to understand and remember", "I like how clear every explanation and definition is to understand",* and, *"It's easier to remember when you can answer quizzes while learning".* They also commented that MERLIN helped them during times when their lecturer was not available and they were online learning on their own. This implies that MERLIN could scaffold and support their online learning during out-of-class times. Students also appreciated the presentation of content in media-rich form, commenting that the inclusion of video, images, and audio explanations contributed to their retention of the topic. Similarly, the self-efficacy quiz provided in MERLIN enabled them to retain the information better, as *"It's easier to remember when you can answer quizzes while learning".* They also commented on MERLIN's ability to "...understand me easily when I ask a certain question", also indicating that MERLIN was able to provide scaffolding to them.

From the findings in Table 3, it can be seen that 82.3% of students reported being satisfied with using the MERLIN chatbot (Item 6, M = 4.24), and 72.6% of students reported that they enjoyed learning with MERLIN (Item 1, M = 4.0), and 61% had fun using it (Item 2, M = 3.90). Students also stated that MERLIN enhanced their understanding of the topic, enabling them to feel more confident in the knowledge that they gained from the chatbot (Item 4, M = 3.81, p = 64%), and, consequently, more engaged (Item 5, M = 3.95, p = 69.4%). This led to 69% of them commenting that they were more motivated to learn about the topic (Item, 3, M = 3.76). The study's findings also showed that student comments that were

solicited further strengthened the survey results (Note: comments are verbatim). In terms of motivation, students also stated that they were very motivated by using MERLIN, commenting that it was *"A fun way to learn a topic", "I enjoyed learning along with Merlin", "It'll keep me engaged, and it makes learning easier and fun",* and, *"I find this MERLIN an interesting a.i to interact with".* These comments suggest a positive attitude from the students towards using MERLIN in their studies, as they commented, *"I've never thought a virtual assistant [MERLIN] can be this good!"*

Table 3 Survey findings for Motivation

	Item Name	Mean (M)	% responses
1.	I enjoyed learning with the MERLIN Virtual Assistant module.	4.00	72.6
2.	I had fun learning with MERLIN.	3.90	61.29
3.	Thanks to MERLIN, I feel more motivated to learn further about this topic.	3.76	60.65
4.	I am more confident now with the knowledge that I have gained from the MERLIN Virtual Assistant	3.81	64
5.	With MERLIN's help, I feel more engaged with this topic.	3.95	69.4
6.	Overall I am satisfied in using the MERLIN Virtual Assistant for my learning of this topic.	4.24	82.3

Table 4 Survey findings for Use of Virtual Assistants in Learning

	Item Name	Mean (M)	% responses
1.	I would like to learn more with such virtual assistants for my other subjects.	4.38	90.33
2.	I would like to use virtual learning assistants more often for my coursework.	4.19	74.19
3.	I believe it is a good idea to use virtual learning assistants for extra knowledge and in depth understanding outside of the class.	4.24	85.24
4.	I found these assistant learning tools very suitable for online learning environments	4.34	87.1

Findings for this construct in Table 4 yielded high positive means for all items, indicating that students' Intention to Use (IU) MERLIN was high. Over 90% of students reported that they would like to use more chatbots or virtual assistants in their other subjects (Item 1, M = 4.38), making the highest item scored in the table, and over 87% of students stated that they found these tools very suitable for online learning environments (Item 4, M = 4.34). 85% of students found having chatbots was beneficial to acquiring additional in-depth of knowledge outside of the classroom (Item 3, M = 4.24), with 74% of students reporting that they wanted to use virtual learning assistants more often in their coursework (Item 2, M = 4.19) With regards to their intention to use chatbots in their learning process, many reported that, *"It saves me time as a student", "This type of virtual assistants can help me a lot when I don't have anyone to refer to for learning purpose", "It will help when im doing assignments on unfamiliar topics during late night sessions",* and, *"It can guide me while I trying to find a certain topic for me to learn".* Their comments indicated that MERLIN was an effective instructional tool to "...*help students to study much better due to the difficulties of learning face to face with the lecturers*" and to enable more active and supported learning to take place during independent online learning times.

As can be seen in the findings, the study's overall findings showed positive and encouraging support for using chatbots in an educational setting. Based on this, a learning framework was developed, as shown in Figure 2. Here, the learning environment was developed at 2 levels, 1) the design of the MERLIN chatbot architecture using Natural Language Processing to enable more human-like interactions with the learner, and pre-trained entity and intent models such as the Conditional Random Field (CRF) and Bernoulli Naive Bayes (BNB) models, respectively; and 2) the design of the MERLIN content that was media-rich and multi-sensory. The combination of technological and multimedia elements in the learning environment yielded a more effective chatbot-student interaction that resulted in positive learning outcomes, where learning was vastly improved, and learning outcomes were successfully achieved.

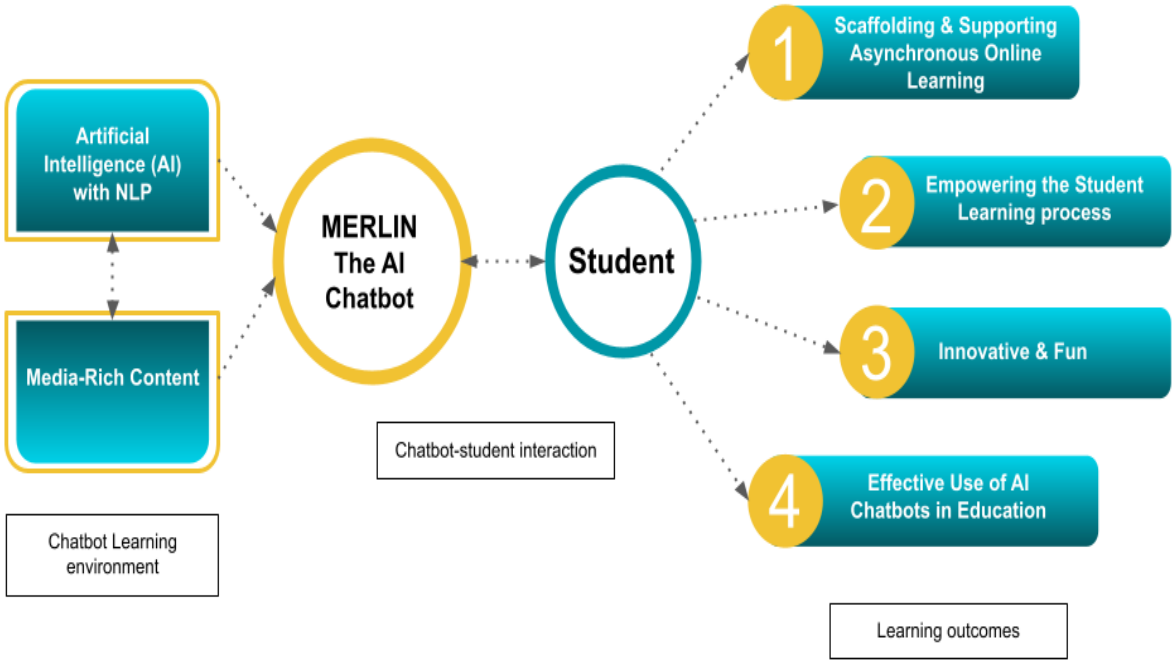

Figure 2 The learning framework for learning with the MERLIN chatbot

Overall, the study's findings show highly favorable student attitudes towards using MERLIN to learn when they were learning independently online. In answering the research question, ***"What is the impact of using an AI chatbot as a scaffolding agent on the students' online learning experiences?"***, the MERLIN chatbot was found to be capable of creating and supporting positive online learning experiences for students in the study. These experiences include:

1. **Scaffolding and supporting asynchronous online learning.** The AI chatbot was effective in scaffolding the student learning process by providing educational support during students' asynchronous learning times. Findings showed most students had commented that MERLIN could support them during times when there was no lecturer available and when they had doubts during their independent online learning times. This result is in line with research by Doyumgaç et al. (2021) on the effectiveness of using chatbots as a guide to better online interactions with students. There are implications that a chatbot can provide scaffolding support to students during their independent online learning times and in line with research by Salloum et al. (2019) and Winkler et al. (2020), and create a more sustainable learning experience where

students are actively engaged and supported in their learning goals, and the teacher facilitates the learning process, and the technology becomes an integral enabler of the learning environment.

2. **Empowering student learning process.** Students reported being more confident and skilful after using MERLIN, which contributed to their overall feeling of satisfaction in their new learning process. Learning was enhanced significantly when students interacted with the chatbot. Multimedia was effective in enhancing the learning in the chatbot. By providing more media-rich content, students were more likely to involve themselves in the learning process, as evidenced by their comments and survey findings, and in line with research by Keshavarz (2020) and Doyumgaç et al. (2021).
3. **Improved engagement in learning content.** Results from the survey and student comments showed that learning and knowledge acquisition was improved and retained, as MERLIN allowed them to further clarify their doubts about the topic and made it easier for them to retain the information. Enjoyment and engagement were reportedly high among these students and using a chatbot to help them during independent online learning times was novel and innovative. Furthermore, the self-efficacy quiz was helpful to the self-evaluation of their learning progress and ultimately in the improvement of their knowledge acquisition, thus addressed the design issue of online learning activities (Liguori & Winkler, 2020).
4. **Effective use of AI chatbots in education.** MERLIN was an effective instructional tool in motivating students to learn more and engage with the content. Students were actively involved in using MERLIN in their learning process, and the use of a chatbot as a scaffold and a virtual learning assistant was very exciting and novel to them, and many reported to wanting more of these assistants for their other courses. The benefits of having these chatbots were invaluable to them during these learning times, when lecturer support was unavailable. Therefore, this showed that using chatbots during independent online learning times allows the learning process to be further sustained until the students and lecturers meet again, and is consistent with research from the Horizon Report 2020 that suggests that using mixed reality technologies like AI was more effective for 21st-century student learning experiences (Brown et al., 2020).

Thus, findings of both qualitative and quantitative data show strong positive support for this learning environment and for the learning framework to provide a guide to educators using chatbots in their classes.

4. Conclusions

Driven by the issue of the lack of pedagogically sound chatbot design in scaffolding and supporting students' online learning, this research study investigated the impact and role of an AI chatbot in enhancing student learning experiences and as a scaffold during their independent online learning times. A multimedia-based AI chatbot named MERLIN was designed with NLP features based on the Conditional Random Field (CRF) and Bernoulli Naive Bayes (BNB) models and presented to students learning a design course. Survey and feedback data were collected from students, and results showed that interacting with MERLIN resulted in higher motivation and engagement levels, increased understanding of the topic, and the request for more AI chatbots to assist them in other subjects. These findings strongly indicate that AI chatbots can be very beneficial in online learning environments as scaffolds to enhance their learning experiences.

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